## REMARKS

In response to the Final Office Action dated May 14, 2010, and pursuant to a request for continued examination (RCE) filed herewith, Applicant respectfully requests reconsideration of the present application in view of the foregoing amendments and remarks set forth below. All of the issues raised in the Final Office Action have been carefully considered and are addressed herein.

Claims 3, 5, 7-20, 29, 34, and 39-47 are pending in this application, of which claims 3 and 34 are independent claims. In this paper, claims 3, 5, 7, 10-19, 29 and 34 have been amended and claims 22, 23, 25-28, 30 and 31 have been canceled (claims 1-2, 4, 6, 21, 24, 32-33, 35 and 36-38 previously were canceled).

Also, dependent claims 39-47 have been added. In particular, new dependent method claims 39-45 respectively correspond, in substantive part, to canceled dependent system claims 22, 23, 25, 26, 27, 30, and 31, which have been recast as method claims depending from independent method claim 34. New system claims 46 and 47 depend from independent system claim 3, and recite limitations originally present in independent claim 3 prior to the amendments herein. Accordingly, all of the subject matter underlying the new dependent claims previously was present in the application as originally filed, and hence no new matter is added.

The application as now presented is believed to be in allowable condition.

## I. Summary of Examiner Interview

Applicant's representative Joseph Teja, Jr. appreciates the courtesies extended by Examiners Peter Luong and Robert Chen in granting and conducting a telephone interview on November 5, 2010 to discuss proposed amendments to independent claim 3 in response to the Final Office Action.

During the November 5 telephone interview, Applicant's representative and the Examiners discussed proposed claim language for independent claim 3 relating to an "open surgical procedure," and propagation of reflected visible light and fluorescence emission through "free space" between an open surgical field of a patient's body and a lens disposed outside of the

patient's body. Applicant's representative also compared and contrasted different embodiments of Applicant's disclosure as illustrated in Figures 1 and 3, respectively, and discussed with the Examiners how salient differences between these two embodiments provide support for the proposed language of independent claim 3 (in particular, propagation of reflected visible light and fluorescence emission through "free space"). Applicant's representative also suggested that the concept of radiation propagation through "free space" would be readily understood by one of ordinary skill in the art to denote propagation of radiation through a non-solid/non-liquid medium such as air (e.g., in contrast to propagation of radiation through an optical fiber). Applicant's representative further indicated that the Applicant would provide in a formal response to the Final Office Action relevant reference materials to illustrate a conventional understanding of propagation of radiation through free space (these materials are attached as an appendix to this response).

Finally, Applicant's representative pointed out to the Examiners how the proposed amendments to independent claim 3 would patentably distinguish the claim from the presently cited references (U.S. Patent No. 6,293,911 – "Imaizumi;" and U.S. Patent No. 5,582,576 – "Hori"). In particular, Applicant's representative noted that while all of the embodiments disclosed in Imaizumi (and Hori) relate to imaging of living tissue (e.g., a lesion) inside a patient's body via a body cavity (e.g., in a deep subcutaneous region), the imaging system of Applicant's claims is specifically directed to open surgical procedures in which an exposed open surgical field of a patient is imaged by a system having one or more optical components disposed outside of a patient's body (and no optical components disposed inside of the patient's body).

Following this discussion, the Examiners indicated preliminarily that the foregoing arguments in conjunction with the proposed amendments appeared to distinguish the claims over the cited prior art, but requested that these amendments and supporting arguments be formalized in detail in the response to the Final Office Action. Of course, the Examiners understandably reserved final judgment on the allowability of the claims pending review of the formal response as filed. The amendments to independent claim 3 (as well as independent claim 34) presented

herein are substantially similar to those proposed and discussed during the telephone interview, and include only minor modifications to take into consideration the Examiners' comments during the telephone interview.

The foregoing summary of the Examiner telephone interview is not intended to limit the claims in any manner. In particular, the Examiner is respectfully encouraged to evaluate the patentability of all claims based solely on the specific language recited in each claim.

## II. Summary of Inventive Embodiments

Following below is a brief summary of inventive embodiments to facilitate the Examiner's understanding of various features recited in the claims as amended herein. The reproduced figures and paragraph numbers referenced below are from U.S. Published Application No. 2005/0182321 A1, published on August 18, 2005, and corresponding to the present application.

As noted immediately above in connection with the Interview Summary, the following summary of inventive embodiments is not intended to limit the claims in any particular manner, but rather is provided primarily to illustrate various concepts to facilitate the Examiner's review of the claims as amended. Again the Examiner is respectfully encouraged to evaluate the patentability of all claims based solely on the specific language presently recited in each claim.

### A. Medical Imaging for Open Surgical Procedures

Fig. 1 of the present application, reproduced below, shows an embodiment of an imaging system 100 for use during open surgery (¶ [0042]).

In one exemplary implementation, the imaging system 100 is surrounded by an operating area that is closed to ambient light (¶ [0043]). Alternatively, the imaging system 100 may be closed to external light sources by using a hood or other enclosure (not shown in Fig. 1) to cover the open surgery (¶ [0043]). The term "operating area" specifically refers to an open surgical site that is closed to ambient light, in which a surgeon conducts an "open surgical procedure" (¶ [0043]). It should be appreciated that, in contrast to "an operating area" as used in the present

application in connection with an open surgical procedure, endoscopic or laparoscopic procedures (such as those described by Imaizumi and Hori) are surgical procedures within a closed body cavity (¶ [0043]).

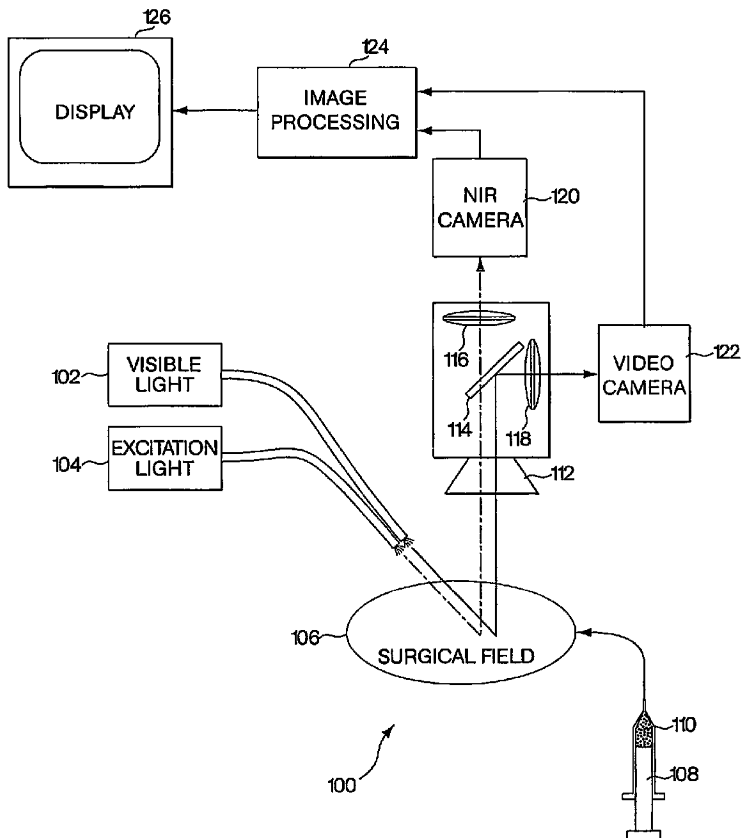



Fig. 1

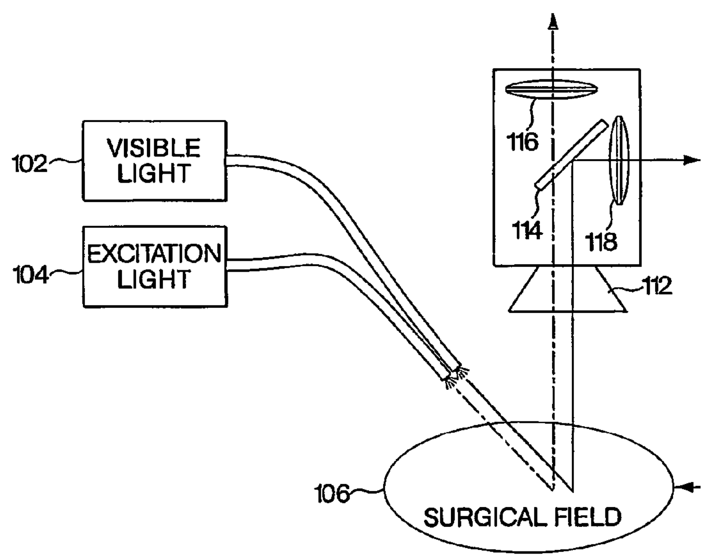
As shown in Fig. 1, an open surgical procedure conducted by a surgeon in an operating area is performed on an exposed surgical field 106 of a patient (e.g., an open chest during a procedure such as a revascularization, cardiac gene therapy, or a coronary artery bypass graft; an exposed region of the body that includes a tumor to be surgically removed; etc.) (¶ [0047]).

For imaging of the exposed surgical field 106 of the patient during the open surgical procedure, a dye source 108 (e.g., a hypodermic needle or an angiocath) is used to inject a dye 110 into the patient, or alternatively spray or otherwise apply the dye 110 to an area of interest (¶

[0048]). In some exemplary implementations, the dye 110 may be highly soluble in blood and therefore administered virtually anywhere in the patient (i.e., the administration of the dye need not necessarily be near the surgical field 106) (¶ [0048]). The dye 110 generally is a fluorescent substance having an emission wavelength that does not interfere with visible light imaging (¶ [0099]). For example, in some implementations the dye 110 may be a "near-infrared" dye having one or more emission wavelengths between 700 nanometers and 1000 nanometers (¶ [0046]; ¶¶ [0049] - [0099]). Such a dye is used to "label" a target pathology in the exposed surgical field 106 of the patient; in this manner, a "visible light image" of the surgical field may be rendered (e.g., on a display device) and superimposed on another rendered image, based on the dye's particular fluorescence emission wavelength(s), so as to simultaneously display a "fluorescence emission image" of the target pathology together with the visible light image of the surgical field 106 (¶ [0005]; ¶ [0041]).

To facilitate both visible light imaging as well as imaging of the fluorescence emission from the dye 110 present in the exposed surgical field 106 of the patient, the imaging system 100 shown in Fig. 1 includes a visible light source 102 and an excitation light source 104 (¶ [0042]). In general, visible light generated by the visible light source 102 may include some, but not necessarily all, of the wavelengths of visible light (¶ [0044]). For example, in one implementation, the visible light source 102 may be a near-infrared-depleted white light source (e.g., a halogen lamp with one or more near-infrared filters); such a light source facilitates imaging of the dye's fluorescence emission that may be nearer to the red end of the visible spectrum (e.g.; near of below 700 nanometers) (¶ [0044]). The excitation light source 104 generally provides radiation at a wavelength that excites the dye 110 and does not interfere with the visible light; to this end, in exemplary implementations, the excitation light source 104 may be a laser diode emitting radiation at 771 nanometers, or may be another type of source that generates essentially single wavelength, narrowband, or broadband radiation to excite the dye 110 (¶ [0046]).

In the imaging system 100 of Applicant's Fig. 1, suitable optical coupling and lenses may be provided to direct radiation generated by each of the visible light source 102 and the excitation light source 104 to an area of interest within the exposed surgical field 106 of the patient (¶ [0046]). For example, as illustrated in Fig. 1, respective optical guides coupled to the visible light source 102 and the excitation light source 104 initially carry the generated visible light and excitation radiation from the sources. The optical guides are appropriately positioned to direct the visible light and excitation radiation, as it exits the end of the guides, toward the surgical field 106 (in the excerpt from Fig. 1 reproduced below, the excitation radiation is represented as a dot-dash-dot broken line, and the visible light is represented as a solid line). The visible light and excitation radiation exiting the guides travel through air ("free space") toward the surgical field 106 (e.g., in an unobstructed line-of-sight optical path to the surgical field).




As also shown in the excerpt of Fig. 1 above, the imaging system 100 includes a lens 112, disposed outside of the patient's body, to receive light from the exposed surgical field 106 and focus the light for image capture (¶ [0100]). More specifically, the visible light emanating from the guide coupled to the visible light source 102 impinges on the surgical field 106, at least a portion of the visible light is reflected from the surgical field, and the reflected visible light (shown as a solid line) travels once again through air (free space) toward the lens 112 outside of

the patient's body. Likewise, excitation radiation emanating from the guide coupled to the excitation light source 104 impinges on the exposed surgical field 106, excites the dye present in living tissue (e.g., a target pathology) within the surgical field, and fluorescence emission resulting from the excited dye (shown as a dot-dash-dot broken line between the surgical field and the lens) also travels through free space toward the lens 112.

The reflected visible light and fluorescence emission from the surgical field 106 of the patient passes through the lens 112 and then impinges on a first filter 114, which in one exemplary implementation is a dichroic mirror that transmits near-infrared radiation and reflects visible light (¶ [0102]). In this manner, the first filter 114 separates the reflected visible light and the fluorescence emission. The fluorescence emission transmitted through the first filter 114 then passes through a second filter 116, and visible light reflected from the first filter 114 passes through a third filter 118 (¶ [0102]). As illustrated in the full view of Fig. 1 reproduced earlier, filtered fluorescence emission then impinges on a near-infrared camera 120, and filtered visible light impinges on a video camera 122 (¶¶ [0102] – [0104]). The images provided by the respective cameras are processed by an image processing unit 124, and a display 126 (e.g., a television, computer monitor, etc.) coupled to the image processing unit renders a visual representation of both a visual light image and a fluorescence emission image of the surgical field (e.g., for viewing by the surgeon) (¶¶ [0105] – [0109]).

B. Endoscopes and Laparoscopes for Medical Imaging Within a Body Cavity

In another embodiment of Applicant's invention as depicted in Fig. 3 of the present application (reproduced below), in contrast to imaging for open surgical procedures as shown in Fig. 1, an endoscope or a laparoscope may be particularly configured for medical imaging of a surgical field deep within a patient's body (e.g., a deep subcutaneous region), either through an existing body opening such as the throat or rectum, or via an incision (¶¶ [0117] – [0119]). Some salient differences between the embodiments of Figs. 1 and 3 are noted below to further underscore some noteworthy features in the embodiment of Fig. 1.

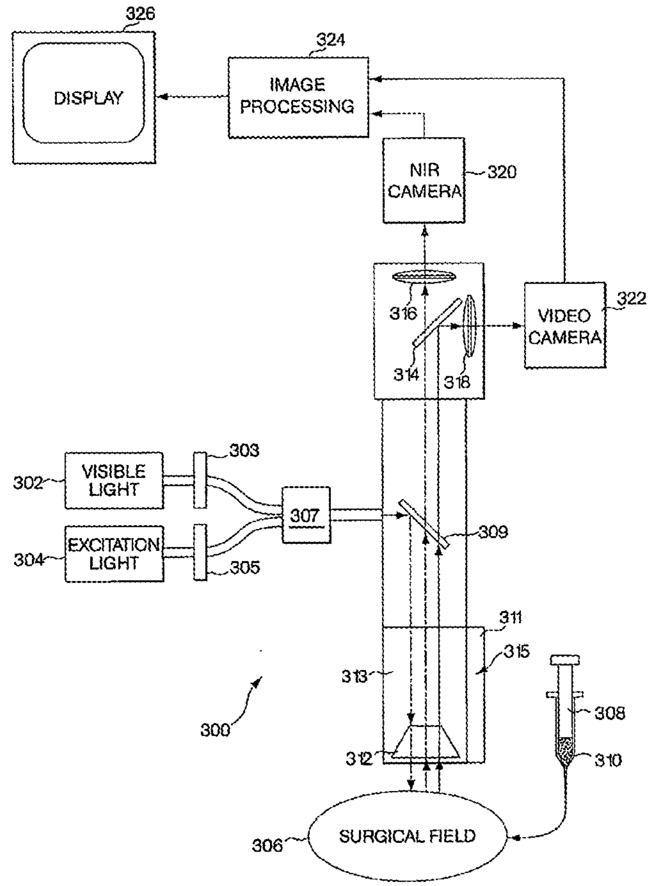



Fig. 3

As illustrated in Applicant's Fig. 3, an endoscope 311 for insertion into a body cavity to facilitate medical imaging of an internal surgical field 306 of a patient carries both incident radiation to the surgical field 306, as well as reflected and emitted radiation from the surgical field 306. To facilitate propagation of the radiation, an optical guide has a first end proximate to the surgical field 306 that includes a lens 312 to facilitate capture of an image of the surgical field, and a second end that couples the image to an electronic imaging device (e.g., the filters 314, 316, 318 and the cameras 320 and 322) (¶ [0006]).

More specifically, in the embodiment of Fig. 3, visible light and excitation radiation, as well as reflected visible light and fluorescence emission, share a first cavity 313 of the endoscope 311 (¶ [0115]). To this end, the imaging system of Fig. 3 includes an optical combiner 307 to

combine the excitation radiation and the visible light into a single combined light source and to couple the combined light source to the optical guide; the combined light source in turn is directed into the first cavity 313 of the endoscope via a dichroic mirror 309 (¶ [0115]). As noted above, the endoscope 311 further includes a lens 312 disposed at an end of the endoscope to be placed closest to the surgical field 306, i.e., inside a body cavity of the patient, through which lens both incident radiation to the surgical field, and reflected/emitted radiation from the surgical field, passes (¶ [0113]).

Accordingly, it may be readily appreciated that while in the embodiment of Fig. 1 a lens 112 is disposed outside of the patient's body to facilitate imaging of an open surgical procedure, in the embodiment of Fig. 3 the lens 312 is instead disposed within a body cavity during medical imaging. Furthermore, there is no optical guide in the embodiment of Fig. 1 to direct radiation from the visible and excitation light sources to the surgical field, and to direct reflected/emitted radiation from the surgical field to other optical components of the imaging system; rather, as noted above, in Fig. 1 radiation travels to and from an exposed surgical field of a patient through air (free space) outside of the patient's body (e.g., in an unobstructed line-of-sight optical path).

It should be appreciated that the foregoing summary of different inventive embodiments is provided solely for the convenience of the Examiner. The Examiner is respectfully requested not to rely upon the foregoing summary for determining whether each of the claims distinguishes over the prior art of record, but to do so based solely on the language of the claims themselves and arguments presented below.

## III. <u>Claim Rejections under 35 U.S.C. § 112</u>

Claims 3, 5, 7-23, 25-31 and 34 were rejected under 35 U.S.C. §112, second paragraph, as allegedly being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. In particular, the Final Office Action states that the recitation of "excludes broadband light sources" in independent claim 3 (as well as independent claims 34) as pending prior to the amendments herein purportedly renders the scope of claim 3 unclear. While not acceding to the propriety of these rejections, the amendments to

independent claims 3 and 34 herein remove the phrase “excludes broadband light sources” from the claim.

Accordingly, it is respectfully requested that all rejections under 35 U.S.C. §112, second paragraph, be withdrawn.

## IV. Claim Rejections under 35 U.S.C. § 103

Claims 3, 5, 7-23, 25, 28-31 and 34 (including independent claims 3 and 34) were rejected under 35 U.S.C. §103(a) as allegedly being obvious over U.S. Patent No. 6,293,911 (“Imaizumi”) in view of U.S. Patent No. 5,582,576 (“Hori”). Dependent claims 26 and 27 were rejected under 35 U.S.C. §103(a) as allegedly being obvious over Imaizumi and U.S. Patent No. 6,167,297 (“Benaron”). Applicant respectfully traverses these rejections to the extent they are maintained over the claims as amended herein.

Independent claim 3, as amended herein, recites:

> 3. An imaging system for an open surgical procedure, the imaging system comprising:
>
> a visible light source to illuminate a surgical field of a patient’s body, the surgical field being exposed during the open surgical procedure, the visible light source providing a range of wavelengths including one or more wavelengths of visible light;
>
> an excitation light source to illuminate the surgical field, the excitation light source including at least one wavelength outside the range of wavelengths of the visible light;
>
> a lens disposed outside of the patient’s body so as to receive at least a portion of reflected visible light from the surgical field and a fluorescence emission from the surgical field, the reflected visible light and the fluorescence emission propagating through free space outside of the patient’s body from the surgical field to the lens, the lens providing focused reflected visible light and a focused fluorescence emission;
>
> at least one electronic imaging device positioned with respect to the lens so as to capture a visible light image of the surgical field based on the focused reflected visible light, and a fluorescence emission image of the surgical field based on the focused fluorescence emission; and
>
> a display that renders a visual representation of the visible light image of the surgical field and the fluorescence emission image of the surgical field.

Independent claim 34 is a method claim that closely tracks the language of similar limitations recited in independent claim 3.

The cited Imaizumi and Hori references, alone or in any combination, fail to disclose or suggest all of the limitations recited in each of Applicants' independent claims.

A. Imaizumi and Hori Are Not Directed to Open Surgical Procedures

First, neither Imaizumi nor Hori is directed to an open surgical procedure in which a surgical field of a patient's body is exposed during the procedure. Rather, both Imaizumi and Hori are directed specifically to endoscope systems and apparatus for inspecting and/or treating living tissue and organs inside a patient's body.

It is noteworthy that Applicant was well aware of Imaizumi, and contemplated specific inventive improvements over Imaizumi at the time of filing the present application (see Applicant's published application, ¶ [0003]). In particular, Applicant's specification acknowledges that Imaizumi describes endoscopic tools that generate images of dye-labeled antibodies superimposed over visible light images captured from within the body. At the same time, however, Applicant's specification notes that Imaizumi only discloses endoscopic applications, and that Imaizumi is not suitable for use in open surgical applications where ambient light may extend into the excitation and/or emission wavelengths of the dye (¶ [0003]).

In contrast to both Imaizumi and Hori, Applicant's independent claims 3 and 34 are directed specifically to an imaging system and method in which an open surgical procedure is conducted on an exposed surgical field of a patient's body.

B. Light Propagation Through "Free Space" – Lens Disposed Outside of Body

Second, neither Imaizumi nor Hori discloses or suggests a lens disposed outside of the patient's body so as to receive at least a portion of reflected visible light and a fluorescence emission from the surgical field, wherein the reflected visible light and the fluorescence emission propagate through free space outside of the patient's body from the surgical field to the lens, as recited in independent claims 3 and 34.

With respect to propagation of the reflected visible light and the fluorescence emission through "free space," Applicant respectfully submits that one of ordinary skill in the art would readily appreciate that, in the embodiment of Applicant's Fig. 1 as discussed above, radiation travels to and from an exposed surgical field of a patient through air (free space) outside of the patient's body. The 1975 textbook "Elementary Physics: Classical and Modern" by Richard Weidner and Robert Sells (hereafter "Weidner and Sells") explains various basic concepts relating to optics, reflection, refraction and lenses. In Chapter 31 of Weidner and Sells, traveling electromagnetic waves are discussed in various media and at boundaries between media. The concept of "index of refraction" is introduced to describe wave-speeds and wave-lengths in respective media, including "free space."

In particular, section 5 of Chapter 31 of Weidner and Sells (provided as an appendix to this response) is devoted to a discussion of index of refraction, in which Weidner and Sells defines the index of refraction of a vacuum, or empty space, as exactly 1. Weidner and Sells points out that for air near the earth's surface, the index of refraction is nearly the same as in a vacuum, and is similarly taken to be 1 for many calculations. Weidner and Sells describes "wavelengths in free space" as corresponding to the wavelength of electromagnetic waves in free space (in which the index of refraction is 1). Accordingly, the terminology "free space" is well-known and readily accepted in the relevant arts of electromagnetic waves to denote the medium of air near the earth's surface, as well as empty space or a perfect vacuum, in which light behaves similarly.

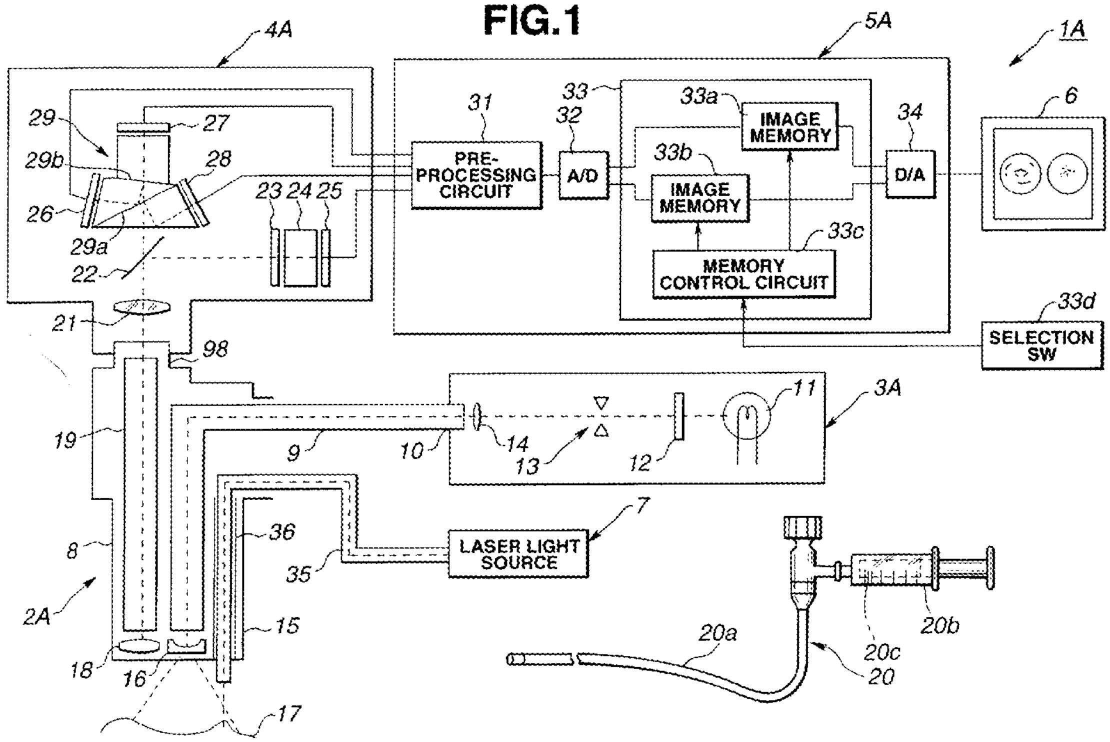
In addition to the Weidner and Sells text, following below are conventionally accepted definitions relating to "free space" derived from various Internet sources:

- <u>Free Space</u>: In communications engineering, when the electromagnetic properties of the medium of air are not significantly different from those of vacuum at the frequencies of interest, the term "free space" is generally applied to communications using electromagnetic waves (radio or light) without wires, waveguides, or optical fibers, generally along an unobstructed line of sight (as in "free-space optical communication") (*see* http://en.wikipedia.org/wiki/Free_space**)**.

- Free Space Transmission: The transmission of radio or optical signals in free space, i.e., space devoid of physical obstructions that might hinder signal propagation. In this context, the term physical obstruction suggests trees, buildings, hills, mountains, and other significant material objects. The term does not suggest atomic, molecular, or particulate matter that commonly is present in the atmosphere. Neither does it suggest water vapor, rain, snow, sleet, or hail. Free space transmission does not include radio or optical transmission through waveguides (*see* http://computer.yourdictionary.com/free-space-transmission).
- Free Space Optics: Abbreviated as FSO, free space optics technology, also referred to as open-air photonics, optical wireless, or infrared broadband, transmits data from point-to-point and multipoint using low-powered infrared lasers. Unlike traditional copper wires or fiber-optic technology, which transmits data by light across glass, FSO uses laser technology to send optical signals through the air using lenses and mirrors to focus and redirect the beams and send data from one chip to another (*see* http://www.webopedia.com/TERM/F/ free_space_optics.html).

In contrast to the "lens" and "free space" limitations in independent claims 3 and 34, and with reference to Imaizumi's Fig. 1 (reproduced below), Imaizumi's endoscope 2A includes an elongated flexible insertional part 8 to be inserted into a body cavity (Imaizumi, col. 5, lines 51-52). A distal part 15 (i.e., the end of the endoscope closest to tissue once inserted into a body cavity) of the endoscope's insertional part 8 emits light to a living tissue 17 in a body cavity through an illumination lens 16 attached to an illumination window (col. 6, lines 7-12). The distal part 15 also has an observation window adjacent the illumination window, to which an object lens 18 is attached (col. 6, lines 14-16). Reflected light and fluorescence stemming from the illuminated living tissue 17 fall on the object lens 18, whereby images are formed at a distal end of an image guide fiber 19 disposed inside the insertional part 8 of the endoscope (col. 6, lines 19-22). Optical images formed on the distal end are transmitted via the fiber 19 to a back end of the image guide fiber (col. 6, lines 22-23).

FIG.1




In Imaizumi, a camera head 4A is directly attached to the endoscope 2A via an eyepiece unit 98 proximate to the back end of the image guide fiber 19 (col. 5, lines 46-50). The camera head 4A includes an image formation lens 21 opposed to the back end of the image guide fiber, other optics, and CCD light sensors to facilitate image capture and processing by processing unit 5A (col. 6, line 24 - col. 7, line 16).

As noted above, independent claims 3 and 34 recite, *inter alia*, a lens disposed outside of the patient's body so as to receive at least a portion of reflected visible light from the surgical field and a fluorescence emission from the surgical field, wherein the reflected visible light and the fluorescence emission propagate through free space outside of the patient's body from the surgical field to the lens. As may be readily observed from Imaizumi's Fig. 1, Imaizumi fails to disclose or suggest this limitation, and in fact *teaches away* from such a limitation. In Imaizumi, radiation propagates a relatively short distance from living tissue 17 within a patient's body to a distal part 15 of an endoscope 2A inserted into a body cavity of the patient. The radiation then

travels through a guide fiber 19 to an eyepiece unit 98 of the endoscope, where it is coupled to an image formation lens 21 inside a camera head 4A. Accordingly, at no point does reflected visible light and fluorescence emission propagate through free space outside of the patient's body from a surgical field to a lens disposed outside of the patient's body; rather, in Imaizumi, light and fluorescence necessarily travel through a fiber guide disposed in an endoscope that is inserted into a body cavity of the patient.

As Hori is directed similarly to endoscope applications, Hori fails to cure the deficiencies of Imaizumi. Accordingly, Imaizumi and Hori, alone or in any combination, fail to disclose or suggest at least the "lens" and "free space" limitations recited in independent claims 3 and 34.

### C. There is No *Prima Facie* Case of Obviousness as the Cited References Fail to Disclose All Claim Limitations

MPEP §2143 lists several examples of rationales that may be used to establish a *prima facie case* of obviousness (i.e., combining prior art elements according to known methods to yield predicable results, simple substitution of one known element for another to obtain predictable results, etc.). Applicants acknowledge and appreciate that the exemplary rationales provided in MPEP §2143 are not all-inclusive, and that other rationales may be relied upon to support an obviousness rejection. The Supreme Court in *KSR International Co. v. Teleflex Inc.*, 550 U.S. 398, 82 USPQ2d 1385 (2007) held, however, that "rejections on obviousness cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness." The key to supporting any rejection under 35 U.S.C. §103 is the clear articulation of the reason(s) why the claimed invention would have been obvious, and an explicit analysis in supporting such a rejection (emphasis added).

For example, MPEP §2143(A) describes in detail the requirements for rejecting a claim based on one illustrative rationale. This section of the MPEP states that to support an obviousness rejection under this rationale, the following criteria **must** be articulated:

- (1) a finding that the prior art included each element claimed, although not necessarily in a single prior art reference, with the only difference between the claimed invention and the prior art being the lack of actual combination of the elements in a single prior art reference;
- (2) a finding that one of ordinary skill in the art could have combined the elements as claimed by known methods, and that in combination, each element merely performs the same function as it does separately; and
- (3) a finding that one of ordinary skill in the art would have recognized that the results of the combination were predictable.

MPEP §2141.02(VI) also sets forth that "a prior art reference must be considered in its entirety, i.e., as a <u>whole</u>, including portions that would lead away from the claimed invention" (emphasis original).

A *prima facie* case of obviousness cannot be made for independent claims 3 and 34 based on Imaizumi and Hori. For example, using the construct of MPEP §2143(A) for purposes of illustration, at least the first required finding set forth in MPEP §2143(A) is met; in particular, as discussed above, the cited references, either alone or in combination, fail to include all of the elements recited in each of Applicant's independent claims. Furthermore, as also noted above, both Imaizumi and Hori teach away from salient claim limitations in that they are directed to endoscope applications and not to open surgical procedures.

As a *prima facie* case of obviousness cannot be made against the presently pending claims based on the Imaizumi and Hori references, Applicant respectfully requests that the rejections of independent claims 3 and 34 under 35 U.S.C. §103(a) be withdrawn.

Claims 5, 7-20, 29, 46 and 47 depend from independent claim 3 and are allowable based at least on their dependency. Similarly, claims 39-45 depend from independent claim 34 and are allowable based at least on their dependency.

## V. <u>General Comments on Dependent Claims</u>

Since each of the dependent claims depends from a base claim that is believed to be in condition for allowance, Applicant believes that it is unnecessary at this time to argue the allowability of each of the dependent claims individually. However, Applicant does not necessarily concur with the interpretation of the dependent claims as set forth in the Final Office Action, nor does the Applicant concur that the basis for the rejection of any of the dependent claims is proper. Therefore, Applicant reserves the right to specifically address the patentability of the dependent claims in the future.

Notwithstanding the foregoing, Applicant wishes to specifically address at this time the rejection made in connection with former dependent claim 23, which recited "the fluorescent substance is soluble in blood" and was directed to "visualizing a blood system." Recitations similar to those originally recited in canceled dependent claim 23 now appear in new dependent method claim 40, and are specifically supported by the disclosure as originally filed (see paragraphs [0047] and [0048] of Applicant's published application).

In numbered paragraph 15 on page 6 of the Final Office Action, it is alleged, *inter alia*, that Imaizumi teaches that "the fluorescent substance is soluble in blood, and the system is capable of visualizing a blood system," citing to Imaizumi at col. 8, lines 1-25; col. 19, lines 56-63; col. 20, lines 26-29; col. 28, lines 10-17; Figs. 1 and 21. Applicant respectfully disagrees with these assertions.

In col. 8, lines 1-25, Imaizumi discusses administration of a fluorescent substance, such as an antibody labeled by indocyanine green, into a patient's body by intravenous injection, ingestion, or dispersing directly onto a living tissue inside a body using an endoscope. Imaizumi notes that the labeled antibody has an affinity for a lesion such as carcinoma, and after some elapsed time the labeled antibody *accumulates in the lesion* (emphasis added). In col. 19, lines 56-63, Imaizumi reiterates that such a labeled antibody *accumulates in a lesion* and is irradiated with excitation light to produce fluorescence which is detected to facilitate recognition of the presence (or absence) of the lesion (emphasis added). In col. 20, lines 26-29, Imaizumi again

reiterates that the labeled antibody *accumulates in a lesion* (emphasis added). Finally, in col. 28, lines 10-17, Imaizumi discusses dual-screen observation of normal light images and fluorescence images on the same monitor to carry out diverse diagnoses while a tumorous lesion or an ulcer is observed.

It is particularly noteworthy that the cited passages of Imaizumi in connection with the rejection of former dependent claim 23 relate to localized accumulation of labeled antibody in a lesion, and **do not disclose or suggest imaging of a patient's circulatory system**. In fact, nowhere in the reference does Imaizumi even use the words "blood," "soluble," or "circulatory."

For at least the foregoing reasons, Applicant's respectfully disagree with the rejection of former dependent claim 23, and traverse any rejection of new claim 40 to the extent the rejection of former claim 23 is maintained over this new claim.

## CONCLUSION

It is respectfully believed that all of the rejections set forth in the Office Action have been addressed. However, the absence of a reply to a specific rejection, objection, or comment set forth in the Office Action does not signify agreement with or concession of that rejection, objection, or comment. In addition, there may be reasons for patentability of any or all pending claims (or other claims) that have not been expressed. Furthermore, nothing in this paper should be construed as an intent to concede any issue with regard to any claim.

In view of the foregoing amendments and remarks, this application should now be in condition for allowance. A notice to this effect is respectfully requested. If the Examiner believes, after this amendment, that the application is not in condition for allowance, the Examiner is requested to call the Applicants' representative at the telephone number indicated below to discuss any outstanding issues relating to the allowability of the application.

The Commissioner is hereby authorized to charge any additional fees which may be required regarding this application under 37 C.F.R. §§ 1.16-1.17, or credit any overpayment, to Deposit Account No. 19-0741. Should no proper payment be enclosed herewith, as by the credit card payment instructions in EFS-Web being incorrect or absent, resulting in a rejected or incorrect credit card transaction, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 19-0741. If any extensions of time are needed for timely acceptance of papers submitted herewith, Applicant hereby petitions for such extension under 37 C.F.R. §1.136 and authorizes payment of any such extensions fees to Deposit Account No. 19-0741.

Respectfully submitted,

Date: 11/10/10

By: [signature]

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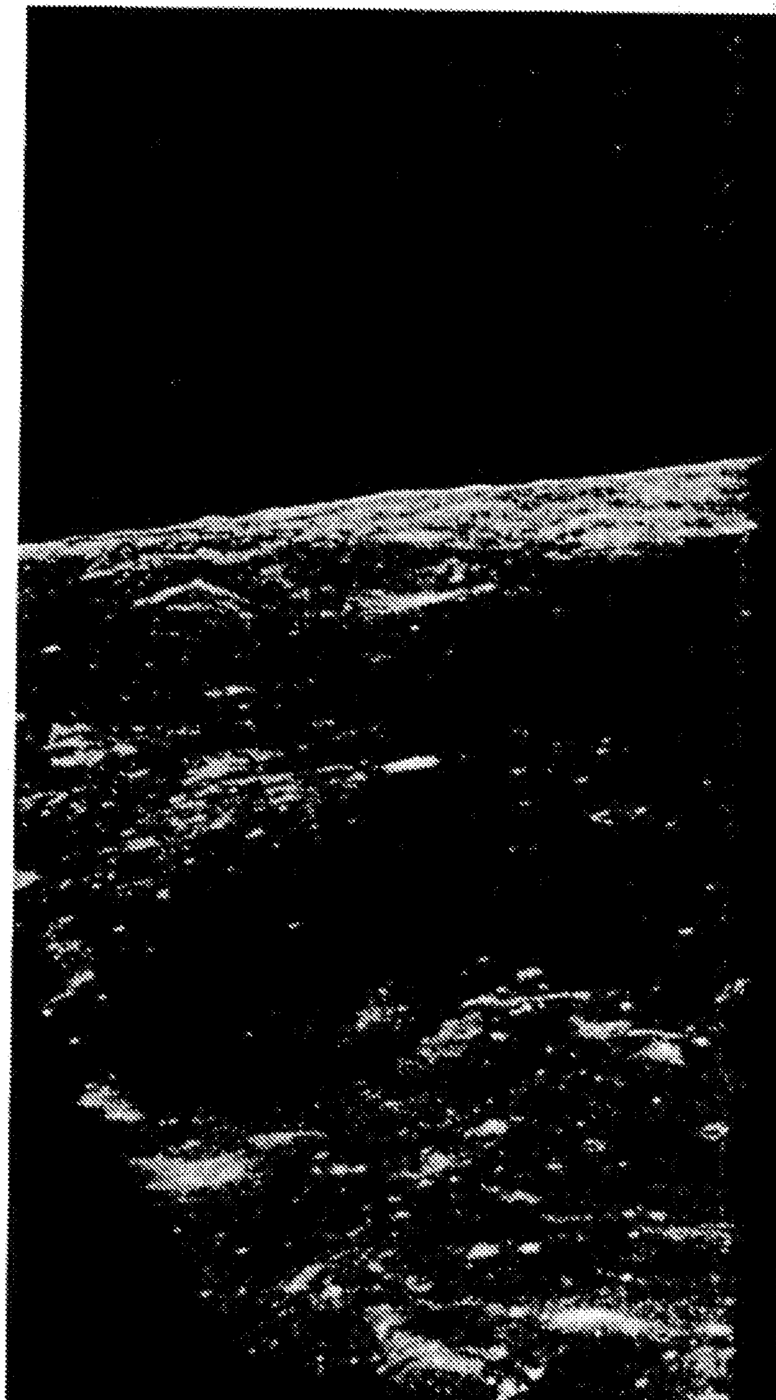
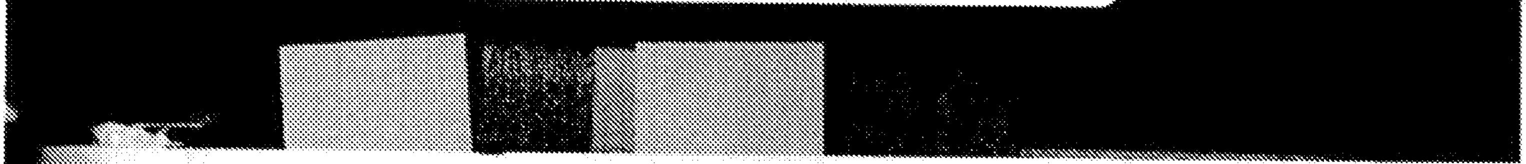
# ELEMENTARY PHYSICS: Classical and Modern



The Apollo 11 lunar module ascent stage photographed from the command service module during rendezvous in lunar orbit. The Earth rises above the lunar horizon. (Courtesy National Aeronautics and Space Administration.)

APPENDIX
Amendment dated May 14, 2010
Application No.: 10/507,253 Filed: 03/21/2005

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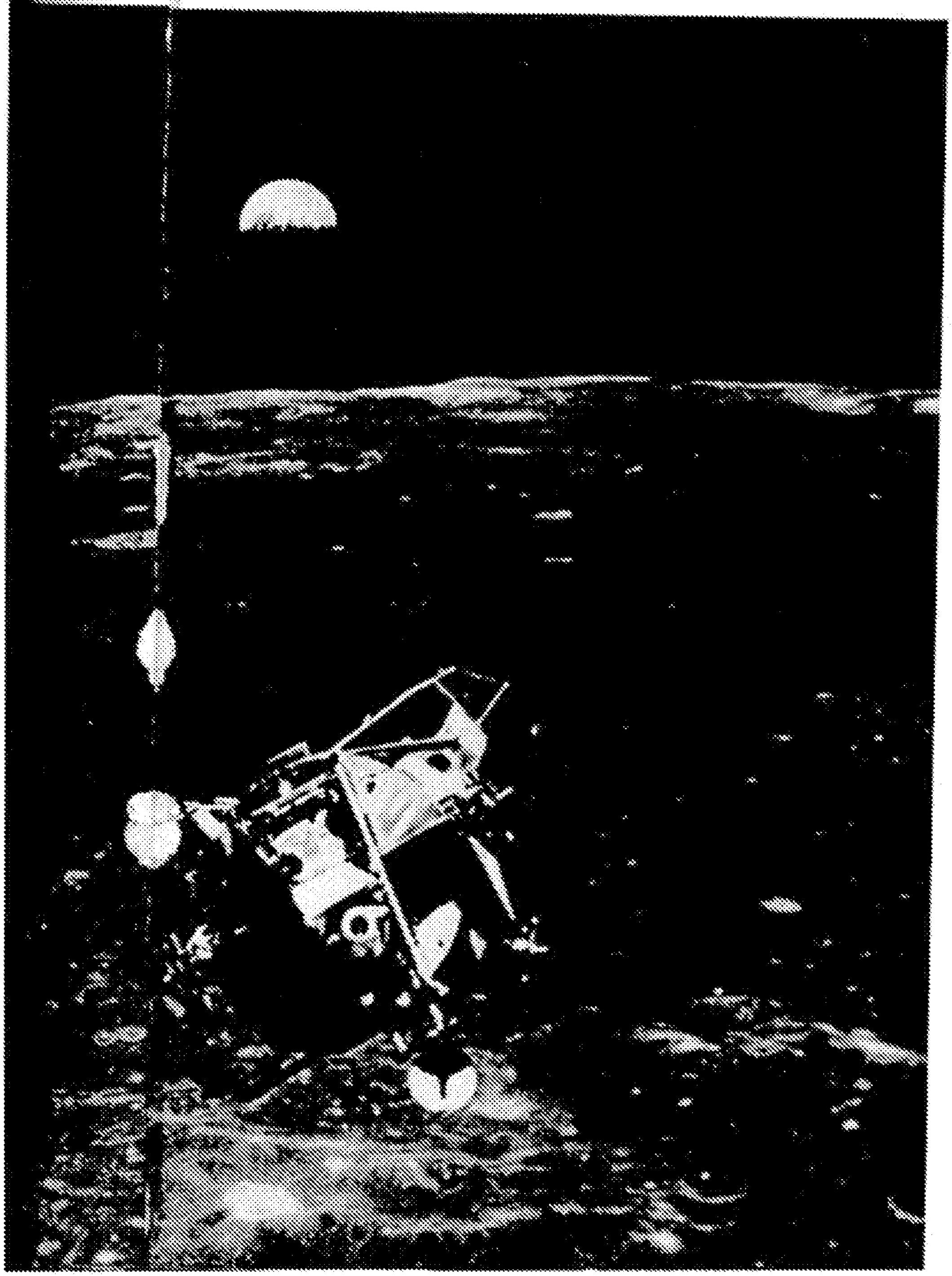


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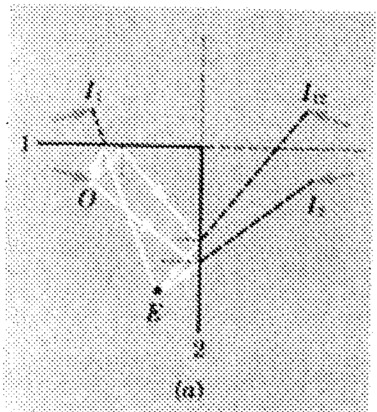


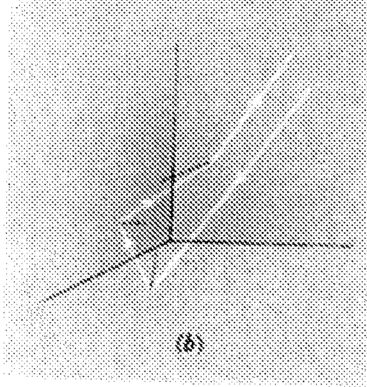


FIG. 31-7. *(a)* Images formed by reflections from two mirrors at right angles. *(b)* A corner mirror.

find the reflected rays and the reflected wavefronts by applying the rule $\theta_1 = \theta_1'$ to each ray. The reflected rays appear to diverge from a single point $I$. To an observer viewing the reflected rays only, these rays and their associated spherical wavefronts seem to come from the point *image* $I$ rather than from their true origin, the point source $S$. The human eye is naïve in that it interprets all rays reaching it as having always traveled in unbroken straight lines. Thus, to the eye (or a camera) it would appear that the source is located at the position of the image, which, from the geometry of Fig. 31-6, is symmetrically located with the source relative to the reflecting boundary midway between them. This image is said to be *virtual,* inasmuch as the rays appear to originate from location $I$, although they do not actually do so.

***Example 31-1***

An object is placed near two plane mirrors at right angles to one another. What images of the object are seen in the mirrors?

See Fig. 31-7*a*, where the object is represented by $O$ and the eye by $E$. Applying the rule $\theta_1 = \theta_1'$ at each reflection, we find that there are *three* virtual images: image $I_1$ formed by reflection from mirror 1, image $I_2$ formed by reflection from mirror 2, and image $I_{12}$ formed by reflections from both mirrors. Image $I_{12}$ can be said to be the image in mirror 2 of the image $I_1$. The object and its three images are located symmetrically with respect to the lines representing the mirrors.

Note that the ray reaching the eye from image $I_{12}$ is *parallel* to the same ray leaving the object $O$; that is, a ray undergoing two reflections at a corner mirror always emerges parallel to the ray entering the object. This same behavior is seen when billiard balls make two "reflections" upon colliding with a corner of a billiard table. When *three* mutually perpendicular mirrors form a corner reflector, any ray undergoing a reflection from each of the three mirrors will emerge parallel to the incident ray, as shown in Fig. 31-7*b*. Whatever its direction, *any* ray encountering a corner mirror is reflected back undeviated in direction (but displaced laterally). For example, a number of corner reflectors, usually made of red glass, are used on the rear fenders of bicycles; any light shining on them is returned toward the light source. Large-scale corner reflectors are in common use as "targets" for radar signals.

## 31-5 INDEX OF REFRACTION

We first recognize that when a wave travels from medium 1, in which its wavespeed is $v_1$, to a second medium 2, in which the wavespeed is $v_2$, the *frequency* $f$ of the wave is *unchanged.* If the wavelengths in the two media are $\lambda_1$ and $\lambda_2$, respectively, we may write

$$v_1 = f\lambda_1 \quad \text{and} \quad v_2 = f\lambda_2 \qquad (15\text{-}8), (31\text{-}3)$$

The wavelength is greater in the medium with higher wavespeed.

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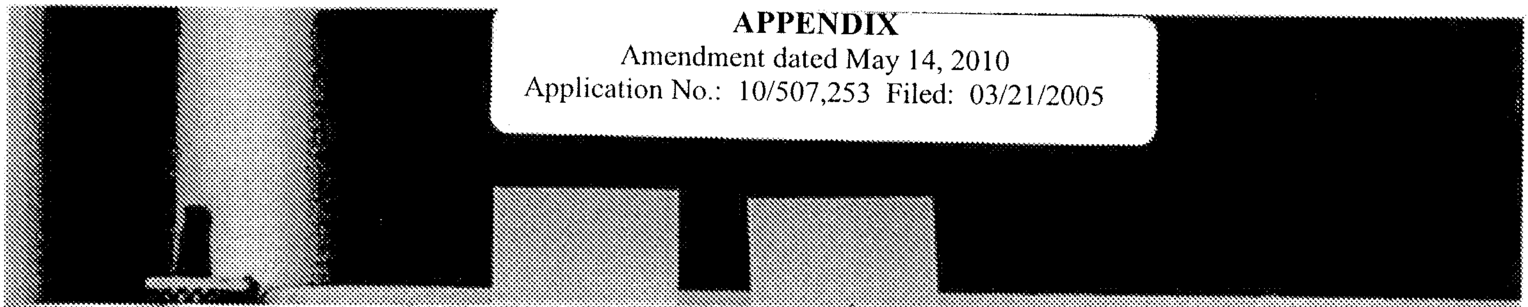

We denote the speed of electromagnetic waves *in vacuum* by $c$. One can then specify the speed in any medium by an *index of refraction n*, the ratio of $c$ to that of the wavespeed in the medium. Therefore,

$$v_1 = \frac{c}{n_1} \quad \text{and} \quad v_2 = \frac{c}{n_2} \tag{31-4}$$

where $n_1$ and $n_2$ are called the indices of refraction for media 1 and 2. By definition, the index of refraction of a vacuum, or empty space, is exactly 1. Light travels through media at a *lower* speed than $c$. Therefore, the indices of refraction always exceed 1. For example, the speed of light through water is found to be $2.25 \times 10^8$ m/s, so that water's index of refraction for visible light is $n = (3.00 \times 10^8 \text{ m/s})/(2.25 \times 10^8 \text{ m/s}) = 1.33$. For air near the earth's surface $n$ is 1.00029, nearly the same as in a vacuum.

Table 31-1 lists indices of refraction to three significant figures for some common transparent materials.

*Table 31-1*

| *Material* | *Refractive index* |
|---|---|
| Diamond | 2.42 |
| Ethyl alcohol | 1.36 |
| Glass (crown) | 1.52 |
| Glass (light flint) | 1.60 |
| Ice | 1.31 |
| Quartz (fused) | 1.46 |
| Sodium chloride | 1.54 |
| Stibnite ($Sb_2S_3$) | 4.46 |
| Water | 1.33 |

The *relative* index of refraction of medium 2 to medium 1, represented by $n_{21}$, is given by

$$n_{21} = \frac{n_2}{n_1} \tag{31-5}$$

which, from (31-4), is equivalent to

$$n_{21} = \frac{v_1}{v_2}$$

It follows, of course, that

$$n_{21} = \frac{1}{n_{12}}$$

In the next section we shall see that the index of refraction, here defined as the ratio of wavespeeds in two media, is the same as the refractive index defined by Snell's law, Eq. (31-2). Thus, one can measure the value of the relative refractive index quite directly by observing the refraction of waves at an interface. The wavelengths in two media can be related to the respective indices of refraction by means of (31-3) and (31-4);

$$\frac{\lambda_1}{\lambda_2} = \frac{n_2}{n_1} \tag{31-6}$$

If the index is large, the wavelength is small. For example, when blue light of wavelength 4000 Å (in free space) enters glass having an index of refraction of 1.500, the wavelength of this *blue* light in glass is *less*, namely 4000 Å/1.500 = 2667 Å. It is customary, however, to characterize a particular color of visible light by its *wavelength in free space*, rather than by its frequency, simply because the wavelength can be measured directly, whereas the frequency is computed from a knowledge of the wavespeed.

*Table 31–2*

| *Wavelength, in air* (Å) | *Refractive index, quartz* |
|---|---|
| 4000 | 1.470 |
| 5000 | 1.463 |
| 6000 | 1.458 |
| 7000 | 1.455 |

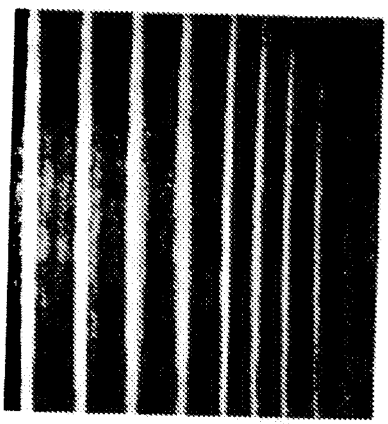

FIG. 31-8. Change in wavelength arising from a change in wavespeed in a ripple tank. (From PSSC *Physics*, D. C. Heath and Company.)

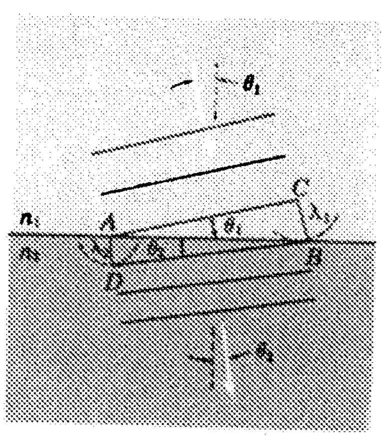


FIG. 31-9. Refraction of plane wavefronts at an interface.

In the case of mechanical waves one can give only relative indices of refraction for a pair of media; there is no unique "medium" corresponding to free space for electromagnetic waves, in which the index of refraction is 1.

Measurements show that the relative index of refraction for a given medium usually depends on the frequency. The index of refraction of a material transparent to visible light rays usually *increases* with frequency. Thus, violet light travels through glass at a lower speed (approximately 1 percent) than does red light, of longer wavelength and lower frequency. Whereas all the component frequencies of white light travel through vacuum at the same speed $c$, the speeds of the various frequencies differ as the light enters a refracting medium. Table 31-2 shows the refractive indices of quartz for light of several wavelengths (in air).

The surface waves on a liquid of varying depth show a behavior similar to that of light waves in that the wavespeed decreases as the depth of the water is reduced. Thus, in the ripple tank one sees the wavefronts compressed, corresponding to a decrease in wavelength, as the waves enter a region in which the depth is reduced; see Fig. 31-8.

## 31–6 REFRACTION

Figure 31-9 shows wavefronts incident from medium 1, in which the wavespeed is $v_1$, the wavelength $\lambda_1$, and the refractive index $n_1$ into medium 2, where the corresponding quantities are $v_2$, $\lambda_2$, and $n_2$. The angle of incidence $\theta_1$ is also the angle between the incident wavefronts and the interface; similarly, the angle of refraction $\theta_2$ can be measured between the interface and the wavefronts in medium 2. We see from the figure that, in the time interval in which the right end of the wavefront advances one wavelength $\lambda_1$ in medium 1, the left end of the same wavefront has advanced one wavelength $\lambda_2$ in medium 2. From the geometry of Fig. 31-9, we have for triangle $ABC$

$$\sin\theta_1 = \frac{CB}{AB} = \frac{\lambda_1}{AB}$$

and for triangle $ABD$

$$\sin\theta_2 = \frac{AD}{AB} = \frac{\lambda_2}{AB}$$

Eliminating $AB$ gives

$$\frac{\sin\theta_1}{\sin\theta_2} = \frac{\lambda_1}{\lambda_2}$$

By using (31-6), this can be written